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(54) Batch process for preparing kraft pulp

Diskontinuierliches Verfahren zur Herstellung von Kraft-Zellstoffen

Procédé en discontinu pour préparer des pâtes kraft

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Description

The present invention relates to processes for preparing kraft pulp in which cellulosic material is treated with recycled pulping process liquids and fresh white liquor for dissolving the lignin therein. More particularly, the present invention relates to the recycling of spent cooking liquor from batch kraft cooking, and the advantageous reclamation of active dry solids and heat therein, while purging the harmful soap separating therefrom.

In the kraft cooking process cellulosic material, most conveniently in form of chips, is treated at elevated temperatures with alkaline cooking liquor containing sodium hydroxide and sodium hydrogen sulfide. The fresh inorganic cooking liquor is referred to as white liquor, and the spent liquor containing the dissolved wood material is referred to as black liquor.

Since the initiation of kraft cooking processes to the present date, one of the most important objectives therein has been the attempt to reduce the energy consumption required to heat up the chips and chemicals. The method generally employed has been to recover heat energy at the end of the cooking process as it can then be used at the beginning of the process, as the chips and chemicals are brought together. In continuous cooking processes, this takes place by heating the chip material with secondary steam obtained from flashing the hot black liquor. In discontinuous, or batch cooking processes, however, the most useful technique is to use the recovered hot black liquor 1) as a direct heating media to be pumped into the digester and 2) to heat-up white liquor by means of heat exchangers.

In connection with this type of low-energy batch cooking, several methods for energy reclamation have been proposed. Some of these developments have resulted in industrial scale embodiments.

US-A-5015 333 describes a method for washing pulp in batch digester. Black liquor is displaced in several steps by pumping wash effluents into the bottom of the digester. The washing method aims to keep the three wash effluents separated from each other. However, the displaced spent black liquor is all collected into the same tank.

Perhaps the most useful prior art method to date is that described in US-A- 4,578,149 by B.K. Fagerlund. This patent relates to an invention in which hot black liquor is displaced from the top of a batch digester to a particular hot black liquor accumulator by pumping wash filtrate into the bottom of the digester. This displacement into the accumulator is continued until the thermal displacement shows a clear drop in temperature after which the liquor is conducted to a separate tank for lower temperature black liquor. The reclamation of heat is then carried out by first pumping lower temperature black liquor into the next batch, and by then pumping hot black liquor from a hot black liquor accumulator, as well as hot white liquor warmed up by heat exchange with part of the hot black liquor into the batch. In this process the digester is brought up to a temperature approximately 20°C below the final cooking temperature, thus providing for a major portion of the energy required in the form of fresh steam for heating the liquor in conventional batch cooking processes. In general, this technology can be classified as a "Two Tank" concept, i.e.--one black liquor accumulator for "hot" liquor and another one for "lower temperature" liquor.

The development of batch cooking technology has thus been characterized by improvements in terms of energy savings therein. Very little attention has been paid, however, to other important issues in cooking technology, such as the effect and variability of the properties of recovered black liquors, uniform cooking conditions, uniform pulp quality, and the sensitivity of these operations to disturbances therein. As an example, such a critical operational necessity as the removal of soap that separates from black liquors has not even been mentioned in the prior low-energy batch literature. The failure to consider these issues, however, has to a great extent been responsible for the tedious and troublesome start-ups of some low-energy batch digesters as well as operation in less than optimal conditions, which results in disturbances, production losses and variability in the degree of cooking and in pulp quality.

In accordance with the present invention, these and other objects have now been realized by the discovery of a method according to claim 1.

Claims 2 to 9 show preferred embodiments of the invention.

In general, the present invention thus provides for overcoming the weaknesses in prior art low energy batch kraft cooking processes by means of a process for preparing kraft pulp which employs three tanks dedicated to particular black liquors, a new liquor recycling sequence, and the removal of soap at an optimum location in the process.

In order to provide a proper description of the present invention and its comparison to the state of the art, it is crucial to understand exactly what happens in a terminal displacement of the kraft batch digester from the top of the digester by using wash filtrate pumped to the bottom of the digester. This understanding is more easily provided with reference to the following detailed description, which refers to the figures in which;

Figure 1 is a graphical representation of the development of temperature and dry solids concentration in a displaced black liquor leaving the digester;
Figure 2 is a graphical representation of the soap concentration during terminal displacement of the kraft batch digester as a function of pumped wash filtrate volume as the percentage of digester volume;
Figure 3 is a graphical representation of residual alkali concentrations of hot black digester charges; and
Figure 4 is a schematic representation of the tanks

and liquor transfer sequences according to the method of the present invention.

Referring first to Figure 1, this figure specifically shows the development of temperature and dry solids concentration of displaced black liquor leaving the digester. It is particularly important in order to understand the present invention to define different characteristic volume percentages describing different aspects of the volume of liquid filling the digester. Thus, and again referring to Figure 1, Vtot, or digester total volume, means the total volume of the empty digester vessel; Vvoid, or digester free, or void volume, means the volume of the digester which is not filled by the chips; therefore, Vvoid = Vtot - Vchip volume. Vliq, or, digester liquid carrying capacity, means the sum of digester void liquid volume and liquid volume in chip material, or Vliq = Vtot - Vsolid phase.

In Fig. 1 the digester total volume, or Vtot, is marked to be 100%. In Fig. 1 the digester liquid-carrying capacity is Vtot minus the volume of the solid phase, or the fiber material, that is typically 90%. (The 90% liquid-carrying capacity value, i.e. all of the liquid in the digester, is derived from the fact that the final pulp consistency in a hydraulically full batch digester is about 10%, thus 90% being liquid.)

In Fig. 1 the digester void (free) volume, Vvoid, is the space not filled by chips, or is Vtot minus chip volume, and is typically 60%. (The 60% free liquid volume value is derived from the fact that softwood chips filling a batch digester typically fills about 160 kg of absolute dry wood solids per digester cubic meter. Furthermore, the specific density of softwood is about 0.4 kg per liter of wood material, thus providing a wood-filled space of about 0.4 m^3 per digester m^3, therefore, 0.6 m^3 thereof is left for free liquid. Of course, this figure varies somewhat according to the degree of chip packing and with the specific density of the wood.)

When pumping colder wash filtrate, which is essentially at a temperature below the boiling point, or about 85 to 90° C, and having a dry solids content of 12%, to the bottom of the digester, the black liquor leaving from the top of the digester will have properties that differ according to the volume of filtrate pumped into the digester.

After pumping in about 60% of the Vtot the digester void volume is at a point where it is about to be completely replaced by the wash filtrate, which will subsequently start flowing out of the digester. This point (transition point 1) is seen in the "dry solids displacement curve" (DS) shown in Fig. 1, which then rapidly declines, tailing down towards the dry solids concentration of the wash filtrate, since the diffusion of dry solids from the internal volume of the chips to the void liquid is a slow process. The wash filtrate concentration level is first reached only after extended displacement volume, i.e.--at 130-140% of the digester total volume. However at transition point 1 the temperature of the liquor leaving the digester is still close to the cooking temperature, due to the rapid heat transfer which takes place from the internal volume of the chips, which includes an almost immobile liquid, to the moving liquor in the void volume.

After pumping in about 90% of the Vtot, the displaced volume equals approximately 100% of the liquid carrying capacity of the digester, and the internal chip heat content is almost totally conducted into the subsequently heated wash filtrate. This point (transition point 2) is seen in the "thermal displacement curve" (TEMP) shown in Fig. 1 which declines rapidly, tailing down towards the temperature of the wash filtrate.

Fig. 2 shows the behavior of soap concentration during terminal displacement of the kraft batch digester as a function of the volume of pumped wash filtrate as a percentage of digester Vtot. It is important to note the opposite development of soap concentration, which is due to the fact that the wash filtrate has a higher soap concentration, i.e.--about 8 g/l, than that of the black liquor at the end of the cook, i.e.--about 2 g/l, and which therefore results in the soap concentration of the liquor leaving the digester starting to increase at transition point 1, when the wash filtrate starts to break through. As the portion of the wash filtrate increases, as displacement proceeds, this concentration then approaches that of the wash filtrate.

According to the prior art, as in US-A- 4,578,149, for example, the displaced liquor is recovered to the hot black liquor accumulator according to the thermal displacement, i.e.--the cut-off to the lower temperature accumulator is determined according to transition point 2. This procedure evidently efficiently recovers the heat, but fails to maintain constant black liquor quality. As the displacement proceeds over 60% of Vtot, the dry solids curve drops sharply. When approaching 90% of displaced volume, the dry solids concentration has decreased close to that of the wash filtrate. As a consequence, the concentration of useful cooking chemicals, and especially residual alkali and sulphur, is very low at the end of the recovery of the hot black liquor. This diluted liquor, however, enters the hot black liquor accumulator, and as the hot black liquor is used for following cooks, black liquor of varying chemical composition will be charged. Consequently, the cooking conditions will vary therein, causing unavoidable variations in the degree of cooking and in the pulp quality. Also, large amounts of undesirable soap are simultaneously recovered in the hot black liquor accumulator.

Fig. 3 illustrates residual alkali concentrations as measured from hit black liquor charges entering an industrial kraft batch digester in a digester house operated according to the process described in US-A- 4,578,149. It is evident therefrom that the residual alkali concentration varies randomly between about 10 and 17 g of Effective Alkali per liter, precisely as Fig. 1 would anticipate, i.e.--the dry solids concentration can vary between about 12.5 and 21%.

Referring next to Fig. 4, the tanks and liquor transfer

sequence of the present invention are illustrated. According to the invention, at the end of a kraft batch cook, the terminal displacement of digester liquor by pumping wash filtrate E to the bottom of the digester is first carried out to the first transition point (see Fig. 1) removing essentially all of the rich spent liquor at cooking temperature and pressure from the free liquid volume. This displaced liquor is digested as B1 and is transferred to the black liquor tank 1, at point B. The exact volume to be recovered is most suitably controlled by monitoring the dry solids concentration in the displaced liquor exiting from digester top with conventional dry solids analyzers. After detecting a clear drop in dry solids concentration, the displaced liquor is switched to enter black liquor tank 2 until a temperature close to the atmospheric boiling point thereof is reached. This displaced liquor is referred to as D1 and is thus recovered. This end point is clearly farther than the transition point 2 (see Fig. 1), which corresponds to the displacement volume at which the heat content of the liquid-carrying capacity volume is being recovered in the displacing wash filtrate, meaning that a complete heat recovery has taken place. In order to further wash the pulp, the pumping of wash filtrate can then be continued, and the corresponding displaced liquor A1 is led to the atmospheric black liquor tank 3, at point AB.

It is noteworthy that when proceeding in this manner, the first black liquor portion, B1, is both 1) essentially at cooking temperature and 2) at the dry solids concentration at the cooking end point. No prior art technology is able to fulfill these two important requirements for purity in a single liquor located in a dedicated tank. On the other hand, the second recovered black liquor, D1, contains diluting wash filtrate which starts to break through at the transition point 1. It is important to note that black liquor, D1, is of varying black liquor quality, and also contains most of the soap since the soap concentration, see Fig. 2, first increases when the filtrate is breaking through into the black liquor after transition point 1. No prior art technology is able to recover a single portion of black liquor in a dedicated tank that contains all of the variability in dry solids content and temperature, and a selectively higher soap concentration. The mixed liquor in black liquor tank 2 is used solely to heat up white liquor and warm water in heat exchangers, and to then end up in black liquor tank 3, compartment S, to be further used as impregnation black liquor AA.

The black liquor tank 3, and its compartment S, now have a significant new role in kraft cooking. That is, the function of receiving compartment S is to remove the separating soap from the cooled and depressurized black liquor from black liquor tank 2, and to isolate the low-in-soap black liquor for impregnation purposes. Compartment S is connected to the main reservoir of the black liquor tank 3 by a pipe that extends from near the bottom thereof in order to prevent the soap from entering the other side or compartment thereof. No prior art technology is able to separate soap from the recovered black liquor and to selectively feed the low-in-soap black liquor back into the process. Practical experience in industrial processes has proven that soap removal in this location of the black liquor transfer sequence is of major importance. Technology such as that described in US-A- 4,578,149 does not even recognize the soap problem, and clearly provides no solution for dealing therewith. In addition, this type of two tank heat recovery concept must, by its very nature, be pressurized, which therefore effectively prevents one from removing the separated soap therefrom. As a consequence, the prior art technology is hampered by repeated operational problems, when the accumulated soap in the black liquor tanks slowly gets transferred to the digester, causing severe problem in maintaining digester circulation, and in preventing efficient liquid displacement operations.

According to the present invention, the kraft batch cook is instituted by filling the digester with chips, filling the digester and soaking the chips with low-in-soap black liquor AA from receiving compartment S in black liquor tank, 3, in order to fully impregnate the chip material with black liquor. The use of an overflow, A2, back to black liquor tank 3, at point AB, is preferred, in order to remove air and the first diluted material. During impregnation, a rather low temperature, below the boiling point, is preferred, since higher temperature impregnation will consume the residual alkali too fast, thus causing impregnation with zero residual alkali black liquor, in turn resulting in higher rejects and non-uniform cooking. This, in fact, is another advantageous feature of the present invention, since the black liquor AA is inherently at the desired temperature, contrary to prior art technologies which feed in black liquor for impregnating at temperatures well above the boiling point.

The black liquor impregnation step is terminated by pressurizing the digester in order to avoid flashing during the following steps, that introduce higher temperature liquors. According to the present invention, the kraft cooking process is then continued by pumping in hot black liquor, B, from black liquor tank 1. In contrast to the prior art, black liquor from tank 1 is of constant temperature and dry solids concentration, which makes it easy to repeat exactly the same hot black liquor charge from cook to cook. This is extremely important because the hot black liquor step has a major chemical effect on the wood, and controls the selectivity and cooking kinetics in the main cooking phase with white liquor. In the prior art, the effect of hot black liquor has been neglected, and a good portion of the reaction degree and variability in pulp quality can be related to the uncontrolled properties of the black liquor quality.

The cooler black liquor, A3, which has been displaced by hot black liquor is conducted to black liquor tank 3, at point AB, for discharge to the evaporation plant and for the recovery of cooking chemicals.

The cooking sequence is continued by pumping in hot white liquor from the hot white liquor storage tank, C, and a smaller amount of hot black liquor, B, 1) simul-

taneously with the hot white liquor, in order to recover as much heat as possible, and to dilute the very high alkali concentration of fresh white liquor and 2) after white liquor charge, in order to flush the lines into the digester. The total volume of hot black liquor, B, consumed in this sequence corresponds to the volume of the recovered hot black liquor, B1, from the previous batch. The displaced liquor, D2, above about atmospheric boiling point, is conducted to hot black liquor tank 2.

After the above-described filling procedure, the digester temperature is relatively close to the final cooking temperature. The final heating up is carried out in conventional manner by using direct or indirect heating. After cooking reactions have proceeded to the desired reaction degree, the batch is ready to be displaced with wash filtrate E as described at the beginning of this description. The sequence can then repeat itself.

Claims

1. Method of producing kraft pulp in a batch digesting process, comprising charging lignocellulosic material to a digester, supplying liquors containing spent cooking liquor and fresh alkaline coooking liquor for impregnating, pretreating and heating of said material, further heating the material to cooking temperature and cooking said material and finally discharging spent cooking liquor and cooked material, whereby the final discharge of spent cooking liquor is performed by displacement so that a first portion of washing liquid is supplied to the digester by displacing the first portion of the spent cooking liquor to a first black liquor tank (1) substantially at the cooking temperature and pressure, and a second portion of said washing liquid is supplied to displace liquor from the digester to a second black liquor tank (2) and recovering heat contained in the liquor from the second black liquor tank (2), **characterized** in

   a) supplying a first portion of washing liquid to the digester substantially until the dry solids content of the liquor leaving the digester starts to drop, thereby displacing a first portion of the spent cooking liquor to said first black liquor tank (1) substantially at cooking temperature, pressure and cook end's dry solids concentration, and
   b) supplying a second portion of said washing liquid to displace liquor from the digester to said second black liquor tank (2) until the temperature of the liquor leaving the digester has dropped to a temperature corresponding to the boiling point of the liquor at atmospheric pressure, using the liquor from the first black liquor tank (1) as pretreating and heating liquor in a subsequent cook, and recovering heat contained in the liquor from said second black liquor tank (2) during transfer of said liquor to a third black liquor tank (3) in which atmospheric pressure is prevailed.

2. Method according to claim 1 , **characterized** in separating and removing soap from the liquid in said third black liquor tank (3).

3. Method according to claim 1 , **characterized** in transferring the liquor from said second black liquor tank (2) to an internal compartment(s) in said third black liquor tank (3) united hydraulically to the main volume of the said third black liquor tank (3).

4. Method according to claim 2 and 3 , **characterized** in separating and removing soap from the liquor in said internal compartment(s) in said third black liquor tank (3).

5. Method according to claim 1, **characterized** in using the liquor from the third black liquor tank (3) as impregnation liquor in subsequent cook.

6. Method according to claim 1, 3 and 5, **characterized** in using the liquor in the said internal compartment(s) of said third black liquor tank (3) as the first impregnation liquor in a subsequent cook.

7. Method according to any of the proceeding claims, **characterized** in using the heat recovered from the liquor in the second black liquor tank (2) for preheating the fresh alkaline cooking liquor to be supplied to the digester.

8. Method according to any of the proceeding claims, **characterized** in supplying a third portion of said washing liquid after cooking in order to further displace liquid from the disgester to the black liquor tank (3) at a temperature below the temperature corresponding to the boiling point of the liquor at atmospheric pressure.

9. Method according to any of the proceeding claims, **characterized** in that said washing liquid is filtrate from a subsequent wash plant for the kraft pulp.

Patentansprüche

1. Verfahren zur Herstellung von Kraft-Zellstoffen in einem Batch-Aufschlußverfahren, enthaltend Einbringen von lignozellulosischem Material in einen Zellstoffkocher, Hinzufügen von Laugen, die verbrauchte Kochlauge und frische alkalische Kochlauge enthalten, zur Imprägnierung, Vorbehandlung und Erwärmung des Materials, weiterhin Erwärmen des Materials auf Kochtemperatur und

Kochen des Materials und schließlich Entnehmen von verbrauchter Kochlauge und gekochtem Material, wobei das letzte Entnehmen von verbrauchter Koch lauge durch Verdrängung durchgeführt wird, so daß ein erster Teil von Waschflüssigkeit unter Verdrängung des ersten Teils der verbrauchten Kochlauge einem ersten Schwarzlaugenbehälter (1) im wesentlichen bei Kochtemperatur und -druck zugeführt wird, und ein zweiter Teil der Waschflüssigkeit zugegeben wird, um Lauge von dem Zellstoffkocher in einen zweiten Schwarzlaugenbehälter (2) zu verdrängen und in der Flüssigkeit enthaltene Wärme von dem zweiten Schwarzlaugenbehälter (2) wiederzugewinnen, gekennzeichnet durch

(a) Einbringen eines ersten Teils von Waschflüssigkeit in den Zellstoffkocher im wesentlichen bis der Gehalt an trockenen Feststoffen der Lauge, die den Zellstoffkocher verläßt, abzusinken beginnt, wodurch ein erster Teil der verbrauchten Kochlauge in den ersten Schwarzlaugenbehälter (1) im wesentlichen bei Kochtemperatur, -druck und trockener Feststoffkonzentration bei Kochende verdrängt wird, und

(b) Einbringen eines zweiten Teils der Waschflüssigkeit, um Lauge aus dem Zellstoffkocher in den zweiten Schwarzlaugenbehälter (2) zu verdrängen bis die Temperatur der Lauge, die den Zellstoffkocher verläßt, auf eine Temperatur entsprechend dem Siedepunkt der Lauge bei Atmosphärendruck abgesunken ist, Verwenden der Lauge aus dem ersten Schwarzlaugenbehälter (1) als Vorbehandlungs- und Erwärmungslauge in einem nachfolgenden Kochvorgang, und Wiedergewinnen von Wärme, die in der Lauge aus dem zweiten Schwarzlaugenbehälter (2) enthalten ist, während der Übertragung der Lauge in einen dritten Schwarzlaugen-behälter (3), in dem Atmosphärendruck vorherrscht.

2. Verfahren nach Anspruch 1, gekennzeichnet durch Trennen und Entfernen von Seife aus der Flüssigkeit in dem dritten Schwarzlaugenbehälter (3).

3. Verfahren nach Anspruch 1, gekennzeichnet durch Übertragen der Lauge aus dem zweiten Schwarzlaugenbehälter (2) auf einen inneren Behälter (S) in dem dritten Schwarzlaugenbehälter (3), der hydraulisch mit dem Hauptvolumen des dritten Schwarzlaugenbehälters (3) verbunden ist.

4. Verfahren nach Anspruch 2 und 3, gekennzeichnet durch Trennen und Entfernen von Seife aus der Lauge in dem inneren Behälter (S) in dem dritten Schwarzlaugenbehälter (3).

5. Verfahren nach Anspruch 1, gekennzeichnet durch Verwendung der Lauge aus dem dritten Schwarzlaugenbehälter (3) als Imprägnierungslauge im nachfolgenden Kochvorgang.

6. Verfahren nach Anspruch 1, 3 und 5, gekennzeichnet durch Verwendung der Lauge in dem inneren Behälter (S) des dritten Schwarzlaugenbehälters (3) als erste Imprägnierungslauge im nachfolgenden Kochvorgang.

7. Verfahren nach einem der vorangegangenen Ansprüche, gekennzeichnet durch die Verwendung der aus der Lauge in dem zweiten Schwarzlaugenbehälter (2) wiedergewonnenen Wärme zum Vorerwärmen von frischer alkalischer Kochlauge, die dem Zellstoffkocher zuzuführen ist.

8. Verfahren nach einem der vorangegangenen Ansprüche, gekennzeichnet durch Einbringen eines dritten Teils der Waschflüssigkeit nach dem Kochvorgang, um weiter Flüssigkeit aus dem Zellstoffkocher in den Schwarzlaugenbehälter (3) bei einer Temperatur unter der Temperatur entsprechend dem Siedepunkt der Lauge bei Atmosphärendruck zu verdrängen.

9. Verfahren nach einem der vorangegangenen Ansprüche, dadurch gekennzeichnet, daß die Waschflüssigkeit ein Filtrat aus einer nachfolgenden Waschanlage für die Kraft-Zellstoffe ist.

Revendications

1. Procédé de production de pâte kraft au cours d'un processus de lessivage par lots, comprenant le chargement de matière ligno-cellulosique dans un lessiveur, la fourniture de liqueurs contenant de la liqueur de cuisson usée et de la liqueur de cuisson alcaline fraîche pour imprégner, pré-traiter et chauffer ladite matière, un autre chauffage de la matière jusqu'à la température de cuisson et la cuisson de ladite matière et enfin le déchargement de la liqueur de cuisson usée et de la matière cuite, le déchargement final de la liqueur de cuisson usée étant ainsi effectué par déplacement de sorte qu'une première partie de liquide de lavage est fournie au lessiveur en déplaçant la première partie de la liqueur de cuisson usée dans un premier réservoir de liqueur noire (1) sensiblement à la pression et la température de cuisson, et une deuxième partie dudit liquide de lavage est fournie pour déplacer de la liqueur du lessiveur vers un deuxième réservoir de liqueur noire (2), et en récupérant la chaleur contenue dans la liqueur du deuxième réservoir de

liqueur noire (2), caractérisé par

a) la fourniture d'une première partie de liquide de lavage au lessiveur sensiblement jusqu'à ce que la teneur en matière sèche de la liqueur quittant le lessiveur commence à diminuer, déplaçant ainsi une première partie de la liqueur de cuisson usée vers ledit premier réservoir de liqueur noire (1) sensiblement à la concentration de matière sèche à la fin de la cuisson, à la pression et à la température de cuisson, et

b) la fourniture d'une deuxième partie dudit liquide de lavage pour déplacer la liqueur du lessiveur vers ledit deuxième réservoir de liqueur noire (2) jusqu'à ce que la température de la liqueur quittant le lessiveur ait diminué jusqu'à une température correspondant au point d'ébullition de la liqueur à la pression atmosphérique, en utilisant la liqueur du premier réservoir de liqueur noire (1) comme liqueur de chauffage et de pré-traitement lors d'une cuisson ultérieure, et en récupérant la chaleur contenue dans la liqueur provenant dudit deuxième réservoir de liqueur noire (2) pendant le transfert de ladite liqueur vers un troisième réservoir de liqueur noire (3) dans lequel la pression atmosphérique est maintenue.

2. Procédé selon la revendication 1, caractérisé par la séparation et le retrait de savon du liquide contenu dans ledit troisième réservoir de liqueur noire (3).

3. Procédé selon la revendication 1, caractérisé par le transfert de la liqueur dudit deuxième réservoir de liqueur noire (2) vers un(des) compartiment (s) interne (s) dudit troisième réservoir de liqueur noire (3) relié hydrauliquement au volume principal dudit troisième réservoir de liqueur noire (3).

4. Procédé selon les revendications 2 et 3, caractérisé par la séparation et le retrait de savon de la liqueur contenue dans le(s)dit(s) compartiment(s) interne (s) dudit troisième réservoir de liqueur noire (3).

5. Procédé selon la revendication 1, caractérisé par l'utilisation de la liqueur dudit troisième réservoir de liqueur noire (3) comme liqueur d'imprégnation lors d'une cuisson ultérieure.

6. Procédé selon les revendications 1, 3 et 5, caractérisé par l'utilisation de la liqueur dudit (desdits) compartiment(s) interne(s) dudit troisième réservoir de liqueur noire (3) comme première liqueur d'imprégnation lors d'une cuisson ultérieure.

7. Procédé selon l'une des revendications précédentes, caractérisé par l'utilisation de la chaleur récupérée de la liqueur dudit deuxième réservoir de liqueur noire (2) pour préchauffer la liqueur de cuisson alcaline fraîche à fournir au lessiveur.

8. Procédé selon l'une des revendications précédentes, caractérisé par la fourniture d'une troisième partie dudit liquide de lavage après la cuisson afin de déplacer en outre du liquide du lessiveur vers le troisième réservoir de liqueur noire (3) à une température inférieure à la température correspondant au point d'ébullition de la liqueur à la pression atmosphérique.

9. Procédé selon l'une des revendications précédentes, caractérisé en ce que le liquide de lavage est filtré depuis une installation de lavage pour la pâte kraft.

Fig.1.

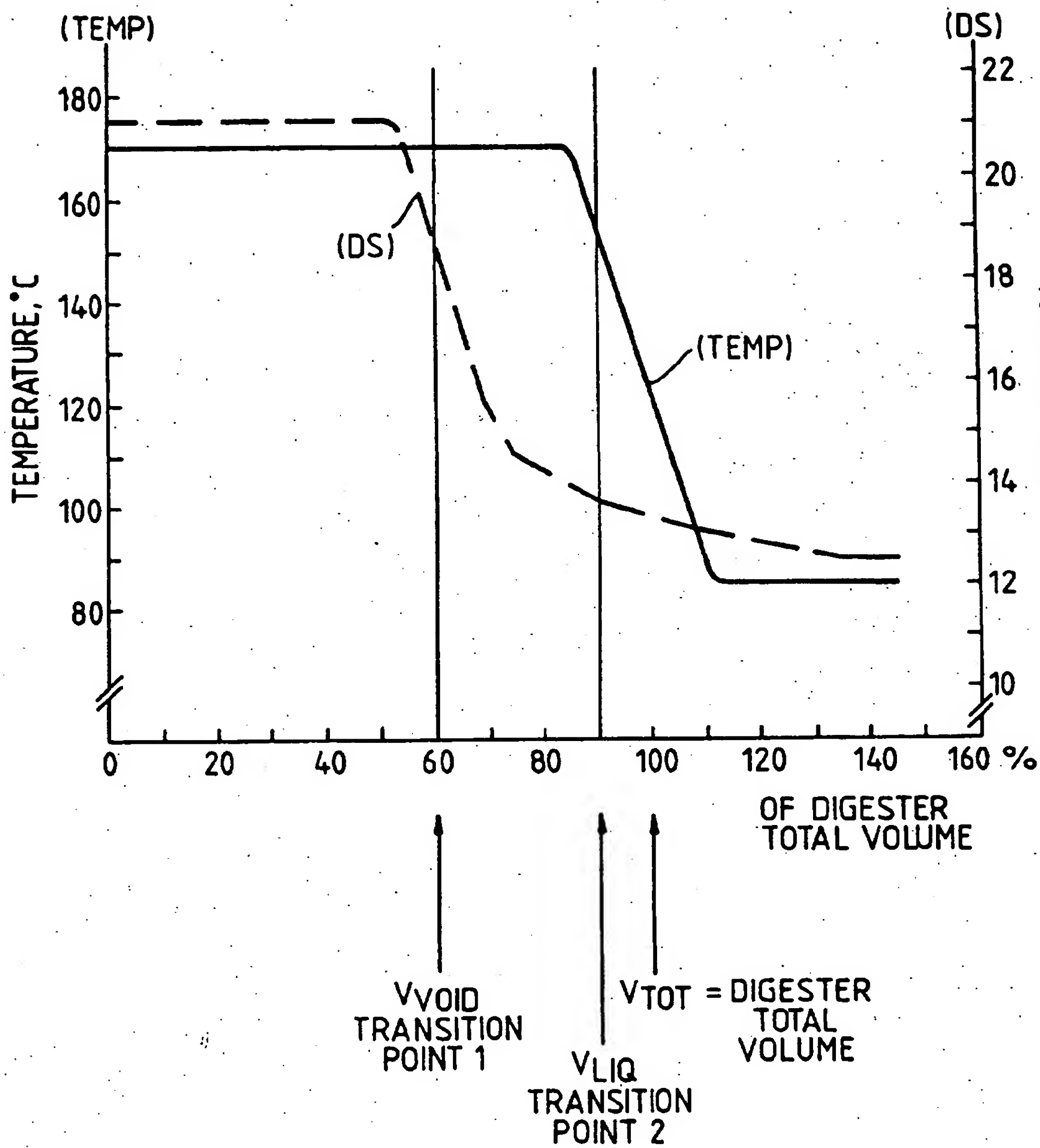

(TEMP)
(DS)
180
160
140
120
100
80
22
20
18
16
14
12
10
TEMPERATURE, °C
DRY SOLIDS, %
(DS)
(TEMP)
0
20
40
60
80
100
120
140
160 %
OF DIGESTER TOTAL VOLUME
VVOID TRANSITION POINT 1
VLIQ TRANSITION POINT 2
VTOT = DIGESTER TOTAL VOLUME

Fig. 2.

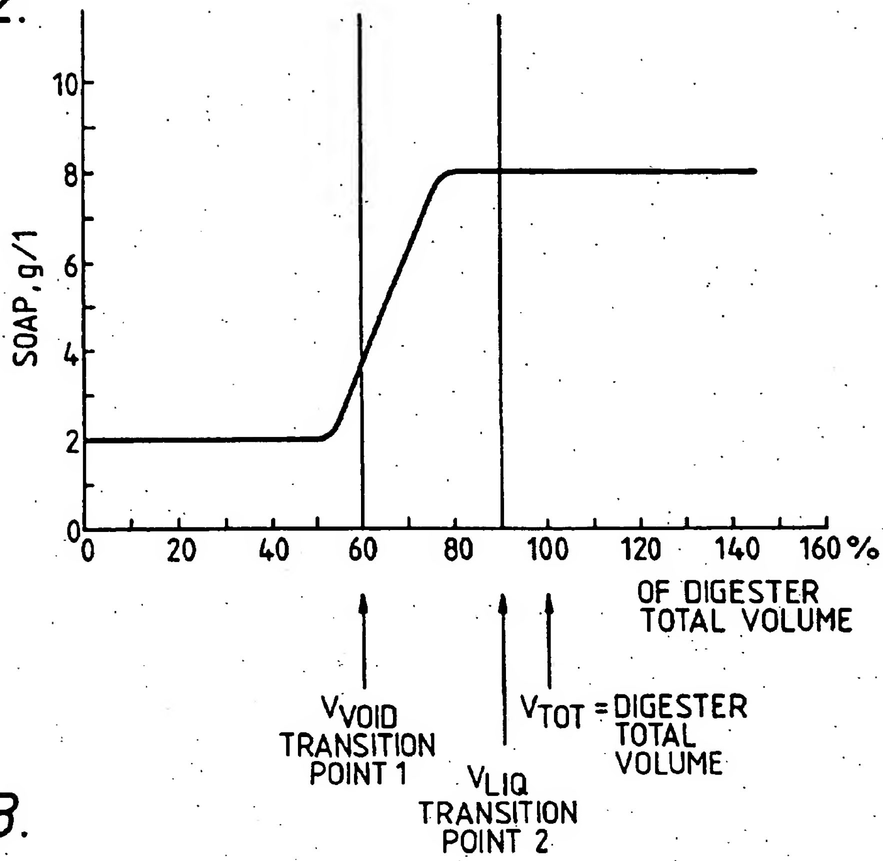

SOAP, g/1
0
2
4
6
8
10
0
20
40
60
80
100
120
140
160 %
OF DIGESTER
TOTAL VOLUME
VVOID
TRANSITION
POINT 1
VLIQ
TRANSITION
POINT 2
VTOT = DIGESTER
TOTAL
VOLUME

Fig. 3.

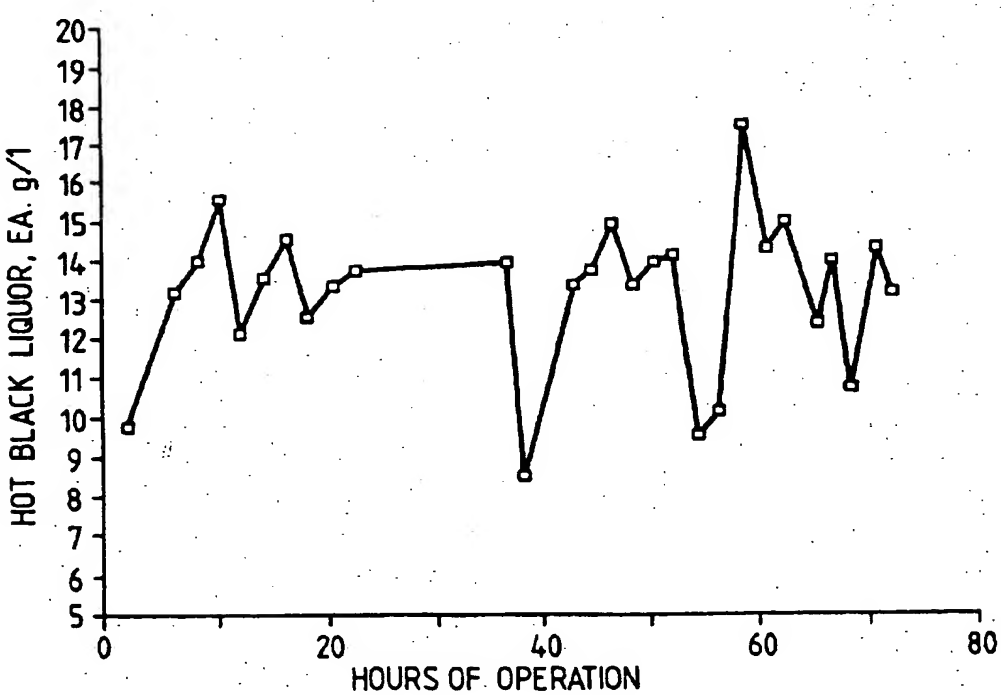
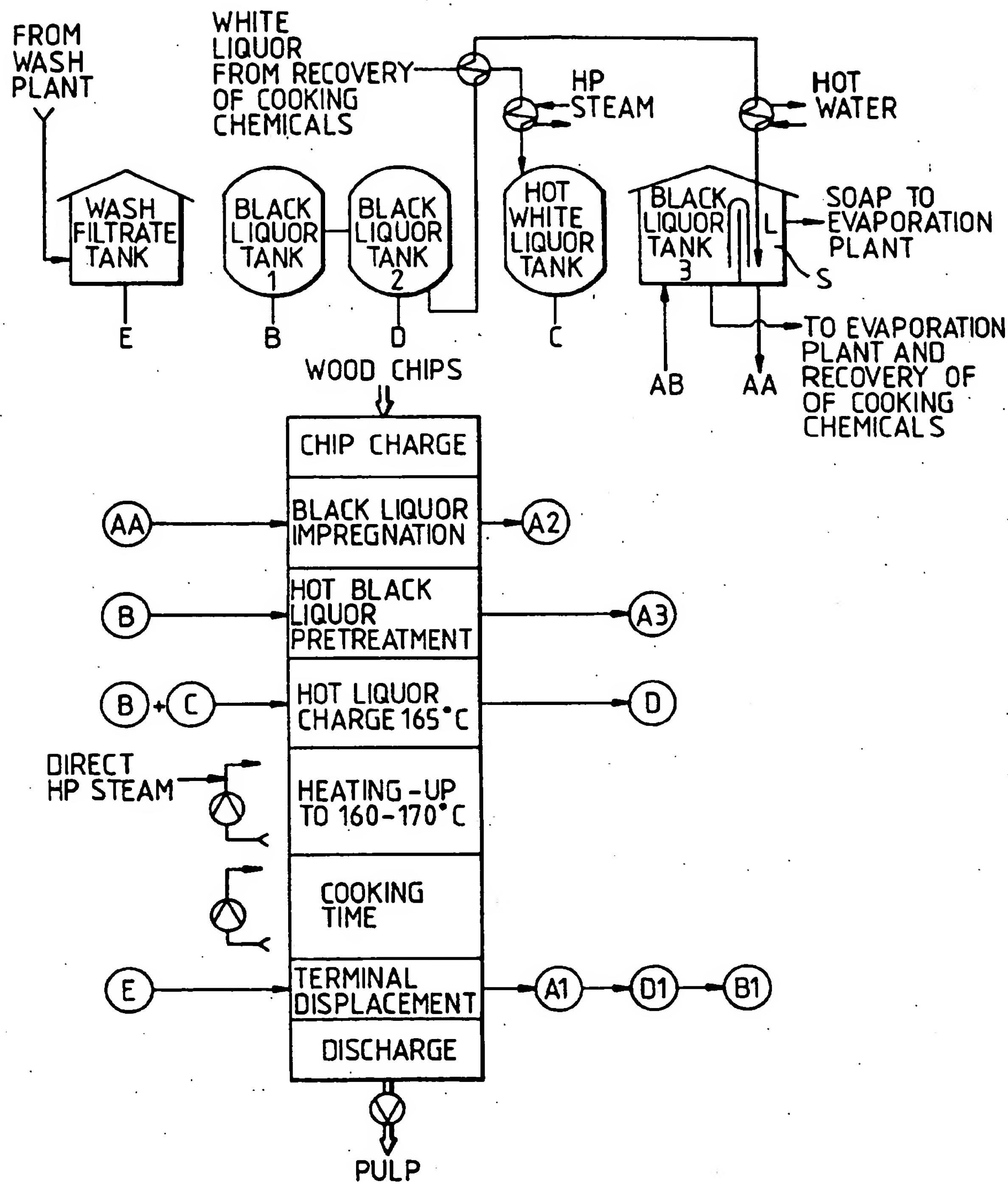

HOT BLACK LIQUOR, EA. g/1
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
0
20
40
60
80
HOURS OF OPERATION

Fig. 4.


FROM WASH PLANT
WHITE LIQUOR FROM RECOVERY OF COOKING CHEMICALS
HP STEAM
HOT WATER
WASH FILTRATE TANK
BLACK LIQUOR TANK 1
BLACK LIQUOR TANK 2
HOT WHITE LIQUOR TANK
BLACK LIQUOR TANK 3
L
SOAP TO EVAPORATION PLANT
S
E
B
D
C
AB
AA
TO EVAPORATION PLANT AND RECOVERY OF OF COOKING CHEMICALS
WOOD CHIPS
CHIP CHARGE
AA
BLACK LIQUOR IMPREGNATION
A2
B
HOT BLACK LIQUOR PRETREATMENT
A3
B
C
HOT LIQUOR CHARGE 165°C
D
DIRECT HP STEAM
HEATING-UP TO 160-170°C
COOKING TIME
E
TERMINAL DISPLACEMENT
A1
D1
B1
DISCHARGE
PULP